Federal Pacific Electric Panels: Fires Waiting to Happen, Debate Waiting to Be Ended

Federal Pacific Electric "Stab-Lok" service panels and breakers are dangerous and can fail, leading to electrical fires. The problem is that some 240-Volt FPE circuit breakers and possibly also some 120-Volt units simply may not work. [NOTICE: 11/10/95 A paraphrase of this article was been posted on Internet in 1995]--Dan Friedman

It has been suggested that there are as many as 28 million of these breakers in use in the U.S. which means that in some conditions as many as one million of them may fail to provide proper fire protection.

But where are they? Most homeowners whose houses are served by these panels are unaware of the hazards. So too are some inspectors and contractors. Because most homeowners do not order periodic electrical safety inspections, the presence of these panels is often undiscovered until an inspection made in the course of renovating or selling a property. Our field experience indicates that even when problems occur with this equipment, often it is simply removed or replaced with little publicity. Neither manufacturers nor some electricians are inclined to frighten consumers.

These breakers can fail to trip at an alarming rate. At a modest overload (135% of rating) switches that had never been touched (never mechanically switched) were energized on both poles. These failed 25% of the time, followed by a lockup that meant the switch would never trip in the future at any overload. Once these switches had been flipped on and off (mechanically energized), failures increased to 36%!

Worse, when individual poles on these switches were energized under the same conditions, 51% of the "virgin" switches failed, and for switches that had been mechanically energized, a whopping 65% of them failed!

When a circuit breaker will not trip in response to an overload there is a serious risk of fire.

Homeowners and renovators who encounter these panels should consider replacing them with new equipment. Panel replacement, can involve significant expense depending on service size and other factors.

But identifying one of these defects can lead to an argument and in some cases, even lawsuits! For example, a knowledgeable inspector or contractor observes one of these panels and recommends replacement. An owner or another inspector, unaware of the background, refuses to cooperate, and insists there is "no problem." Who's right?

There is indeed "a problem." FPE panels and circuit breakers are a "safety-related defect." In some conditions the equipment may not provide the safety protection (against fire) that was intended.

This defect is associated with FPE panels and circuit breakers manufactured in the 1970's and possibly extending to current equipment. Testing was performed in 1982-3 by Wright Malta Corporation for the US Consumer Product Safety Commission.

What actually happens to cause unsafe conditions? Testing performed on FPE 2-pole (240V) circuit breakers indicated that in some overload conditions, particularly when one pole of the breaker is overloaded, the circuit breaker will not trip. Some tests showed that as many as 65% of the circuit breakers would malfunction.

Once this malfunction has occurred the breaker is "locked" and it will not trip under any circumstances, creating an even more serious fire hazard.

Are there real-world instances in which a current overload occurs on just a single "leg" of a 240-Volt circuit? Sure. At least some **clothes dryers and electric ranges** split the 240-V delivered to the appliance to run individual components such as a dryer drum motor or individual heater elements. **Multiwire branch circuits** which share a common neutral wire also serve different loads in a building.

Special Notice: Multiwire Branch Circuits - warning: to avoid overheating neutral wire and shock hazards involving multiwire branch circits, it is important to assure that each of the individual circuits is on opposite poles (in the panel) from the other. In most panels this is accomplished, in fact forced, by using a 240-V common-trip-tie breaker (ganged together switches) which forces individual circuits onto opposite poles. However in FPE panels, the panel bus design does not provide this assurance. Ref: "Safe Wiring Practice," Rex Cauldwell, Journal of Light Construction, letter March 1995, p.6.

It is possible that there are similar failures among single-pole (120V) breakers. At least one case of a single-pole 120-Volt FPE GFCI breaker which failed to trip has been reported.3 Furthermore, simply purchasing new circuit breakers of the same type from the same manufacturer may not correct the problem. And only special FPE breakers fit in the FPE "Stab-Lok" electric panel.

When this issue was examined in the early 1980's, FPE's opinion was that the chances of an overload occurring on only a single pole of a 240-volt breaker were very small. In our view there are some very common real-world examples where single-pole loading in a 240-volt breaker might include failures: multi-wire branch circuits and in electric clothes dryers where one of the heating elements shorts to the steel case of the dryer.

The circuit breakers do not directly cause an electrical fire. Some other failure must occur which in turn causes an overload of the circuit "protected" by the FPE breaker. When the breaker fails to trip in response to the overload it has failed to provide the protection intended, and a fire may result. That indirection is why we call this a "latent safety defect."

Why we call this a "latent safety defect" rather than just "hazardous" or "dangerous" needs more explanation. Unfortunately, some people who stand to face big costs grasp at fine distinctions about the failure mechanism in order to avoid facing the problem.

When a defect is itself likely to cause injury directly, such as live wires poking out of the wall by the bathroom sink, we call it a "hazard."

When a defect does not directly cause the injury or loss, such as a circuit breaker which may fail to trip when something else is causing an unsafe overcurrent, we call it a "latent safety defect.

Either way, it's still a problem that needs prompt attention.

Is this a linguistic debate or is it really an issue in the field? You bet it's an issue. Recently during an examination by a Maryland home inspector4,5 an FPE panel, was observed and flagged as a potential hazard which should be remedied. The property owner, concerned about his sale, complained and threatened to sue the inspector.

We were able to provide the inspector with referral to Dr. Jess Aronstein, an engineer in Poughkeepsie, New York, who in turn provided supporting documentation: reports on this problem, a bibliography, and a press release from FPE.

In another example of the dangers of this "latent safety defect," Dr. Aronstein reported that during a disturbance in a jail, a guard hit a gang-switch in an FPE "Stab-Lok" load center in the cell block area. The breaker did not trip. Rather, it shorted to ground in the switch, blowing a hole in the cover plate.6,7

Building inspectors and renovators often face the discovery of a product which is potentially harmful, which should be replaced, but for which there is little public documentation to justify their position.

Disagreement among people affected by this issue means that it's necessary to be able to cite actual research.

Reports on FPE Equipment Defects

The following **reports on defects** (non trip and burning) of FPE Stab-Lock Circuit Breakers8 were obtained from Consumer Product Safety Commission by request, under the Freedom of Information Act:

- "Status Report - Evaluation of Residential Molded Case Circuit Breakers", Wright-Malta Corp., (For U.S. Consumer product Safety Commission, Project# CPSC-C-81-1455), August 10, 1982 (Contains analysis of mechanism of failure of FPE two-pole Stab-Lock breakers.)
- "Failure Analysis of Residential Circuit Breaker Panel", Wright-Malta Corp., (For U.S. Consumer product Safety Commission, Project #CPSC-C-81-1455), May 20, 1982 (Contains failure analysis of FPE Stab-Lock panel that ignited due to failure of buss-bar interconnections in the backside of the panel.)
- "Phase II Report, Evaluation of Residential Molded Case Circuit Breakers", Wright-Malta Corp., (For U.S. Consumer product Safety Commission, Project# CPSC-C-81-1455), March 10, 1984 (Contains experimental analysis of materials, construction, and performance of molded case circuit breakers, including FPE. Lack of corrosion resistance of certain internal parts is considered to be a factor in the failure of the circuit breakers.)
- "Final Report: Calibration and Condition Tests of Molded Case Circuit Breakers," Wright-Malta Corp., (For U.S. Consumer product Safety Commission, Project #CPSC-C-81-1429), December 30, 1982 (Extensive calibration and functional testing of FPE breakers. Substantial percent failures to trip on overload).

Building professionals who have questions about this equipment, particularly in cases of suspected failure of the equipment are invited to contact the author.

Dan Friedman is a building consultant in Poughkeepsie, NY. He served as chairman of both the Education Committee and the national Technical Committee of the American Society of Home Inspectors. Contact information is at his website.